Simultaneous (Dual) Nonelectric Priming Assembly

Market Overview

Naval Surface Warfare Center (NSWC)—Crane Division

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Executive Summary

A general overview of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) and its prospective market opportunities are presented in this analysis. Based upon the Priming Assembly's functionality and prospective advantages, three potential markets were identified; the *military market*, the *civilian first responder market*, and the *general demolition market.* Each of these potential markets is defined and quantified, and then market drivers and influences are examined.

Technical Synopsis

The Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) claimed in Navy Case 100,080 is a plastic blasting accessory that allows for the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials[1]. The invention of this system, which is useful in applications needing simultaneous, nonelectric initiation of multiple explosive charges, was prompted by the fact that the current solution for these types of applications can be dangerous and unreliable.

Currently, similar effects to the Priming Assembly are obtained by taping the multiple lengths of nonelectric explosive initiation materials together in the field[2]. This ad hoc method can create any of the following results; poor reliability, excessive explosive weight, excess time on target and poor results. Significant problems within the larger explosive blast system can result from any of these issues. There are currently several devices that can help reduce these risks, but none of them is able to perform dual priming of reliable, simultaneous, initiation of multiple lengths of nonelectric initiation materials, and hence the invention of the Priming Assembly.

The Priming Assembly is, "a plastic body with a series of features designed to accept the input of up to two (2) explosive detonators, a cavity of explosive booster material, and output channels for multiple nonelectric initiation materials." Sufficient booster material can be placed in the booster cavities to ensure the reliable initiation of multiple lengths of nonelectric materials. Further, the assembly, in the form of a spool, serves as packaging for accommodating lengths of nonelectric priming leads, which eliminates the need for the precision cutting of the lengths in the field[3]. The Priming Assembly may provide the following prospective advantages:

- Decreased Set-up Time
- More Reliable
- Near simultaneous detonation
- Reduced and more efficient use of explosive material
- Increased safety

[1] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.
[2] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.
[3] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.

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Markets and Competitive Landscape

Prospective end users and their corresponding employment projections are used in defining and quantifying the market identified. The rate at which demolition is performed by blasting is also considered. Competition for the Priming Assembly may include existing industry firms within the military, civilian first responder, and general demolition markets. The composition was found to be relatively fragmented; only one firm of the 56 in the Explosives Manufacturing industry is not classified as a small business[4]. It is important to note that due to the nature of this technology, publically available information is limited.

In addition to broad industry characterizations, potential substitutes for the Priming Assembly may include *currently deployed ad hoc systems*, *alternative demolition methodologies* and *existing priming assemblies*. These substitutes and the firms that provide them are examined in comparison to the present invention.

Conclusion

The components, functionality, and prospective advantages of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) may prove more valuable in some markets than in others. Based upon the rates at which demolition is performed by blasting, the military and general demolition markets may prove more viable than the civilian first responder market. While a civilian first responder market appears to exist in disaster clean-up and law enforcement special operations applications, research revealed that first responders typically call in demolition contractors to perform these types of activities[5]. Further, when first responders do take on such situations, demolition by blasting is usually not the first method employed[6]. With that said, a recommendation of pursuing one market or another is not given, but the observations within this report may provide substantial data for one to make such a decision.

The Priming Assembly claims to allow for the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials, more quickly, reliably and safely than the currently used ad hoc method (taping the multiple lengths together). Based upon the data examined, there are multiple imperfect substitutes within the current marketplace. The ad hoc method has little cost associated with it; however, it can be relatively dangerous and time consuming. Currently available priming assemblies do not allow for simultaneous detonation[7]. With that said, the Priming Assembly's prospective advantages may offer viable points of product differentiation and foster competitive ability in certain applications.

[4] http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf
[5] http://www.demolitionassociation.com/Portals/0/pdfs/DC_Strengthen_First_Response.pdf
[6] http://ezinearticles.com/?Demolition---There-Are-Many-Different-Variations&id=1072853
[7] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.

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1 Introduction

The Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) (Priming Assembly) claimed in Navy Case 100,080 is a plastic blasting accessory that allows for the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials[8]. The invention of this system, that is useful in applications needing simultaneous, nonelectric initiation of multiple explosive charges, was prompted by the fact that the current solution for these types of applications can be dangerous and unreliable. Currently, similar effects to the Priming Assembly are obtained by taping the multiple lengths of nonelectric explosive initiation materials together in the field[9]. This ad hoc method can create any of the following results; poor reliability, excessive explosive weight, excess time on target and poor results. Significant problems within the larger explosive blast system can result from any of these issues. There are currently several devices that can help reduce these risks, but none of them are able to perform dual priming of reliable, simultaneous, initiation of multiple lengths of nonelectric initiation materials, and hence the invention of the Priming Assembly.

The Priming Assembly works to overcome those limitations by providing a plastic assembly that decreases time on target, increases reliability, and has simultaneous detonation functionality. This assessment examines the following potential applications:

- Special Operations in Military
- Demolition, including in mining
- Disaster Clean-Up
- Special Operations in Law Enforcement, including door breaching

This assessment also looks at the potential corresponding markets to these applications in which the prospective advantages of the Priming Assembly may find relevance. These potential market characterizations include:

- Military
- General Demolition
- Civilian First Responder

Further, additional factors impacting the technology's technical merit and market viability are explored. The report is broken down into the following main sections:

- Technical Synopsis
- Applications
- Markets
- Competitive Landscape
- Cautions and Considerations

[8] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.
[9] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.

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While this report is not undertaken to recommend one action over another, the information contained herein should provide substantial data to make certain decisions. With that said, it must be noted that due to the nature of this technology (i.e. explosive accessory), publically available information was somewhat limited.

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2 Technical Synopsis

The Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) claimed in Navy Case 100,080 is a plastic blasting accessory that allows for the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials[10]. The invention of this system, that is useful in applications needing simultaneous, nonelectric initiation of multiple explosive charges, was prompted by the fact that the current solution for these types of applications can be dangerous and unreliable. Currently, similar effects to the Priming Assembly are obtained by taping the multiple lengths of nonelectric explosive initiation materials together in the field[11]. This ad hoc method can create any of the following results; poor reliability, excessive explosive weight, excess time on target and poor results. Significant problems within the larger explosive blast system can result from any of these issues. There are currently several devices that can help reduce these risks, but none of them are able to perform dual priming of reliable, simultaneous, initiation of multiple lengths of nonelectric initiation materials, and hence the invention of the Priming Assembly.

2.1 Background on Explosions

The technical aspects of the explosion preparation process are helpful in understanding the field of the Priming Assembly invention. Although explosions are nonlinear processes by nature and not fully understood[12], an explosion is defined as a rapid increase in volume and release of energy in an extreme manner. It is initiated when stimuli such as heat, impact, friction or shock are brought into contact with a metastable chemical compound, resulting in rapid changes in its state. Explosions begin with a smaller reaction that creates shock waves, which is the beginning of the explosive train. Also known as a triggering sequence, an explosive train is a sequence of events leading up to the detonation of explosives. According to the inventor[13], the triggering sequence for explosives includes the following primary components:

1. A **detonator** is a device that triggers an explosion. The initiation mechanism within the detonator could be either electric or nonelectric.

    a. An **electric initiator** is a hot wire which heats when electric current flows and starts the starter mix burning rapidly.

    b. A **nonelectric initiator** has no wire but includes a primer.

2. A type of transfer line:

    a. A **detcord** is a fabric rope with an explosive core which can lead thousands of feet to the bomb.

[10] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.
[11] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.
[12] http://www.aero.org/publications/crosslink/fall2006/02.html
[13] Telephone Conversation with Eric Scheid

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b. A **shock tube** is a plastic tube with a small amount of explosive that burns enough to start the detonator at the other end.

3. An **explosive charge**, which is defined as a quantity of explosive material, containing a great amount of stored energy, that when initiated, produces an explosion, including a:

a. A **booster charge** connects a low energy explosive and high energy explosive, increasing the energy of the initiating explosive and triggering the main charge.

b. The **main charge** detonates the larger or main explosion.

While validating the components necessary to create an explosion and more specifically the explosive train, sources varied by which components should be included and by the terminology used to refer to these components. With that said, the following chart[14] gives another perspective on the components of explosive trains and how the progression works toward to a larger explosion. The difference between this chart and the above outline based upon discussions with the inventor is not substantial but provides more detail in regard to the explosive train.

Component	Action	Notes
Primer	Initiating device	Initiated by percussion, stabbing, electrical current, heat, etc.
Detonating	Detonate base charge	Ignited by primer. Small quantity of primary explosives
Flash	Ignite base charge	Ignited by primer. Burn explosively but will not detonate
Delay	Controlled time delay	Pyrotechnic formulation burns without gas
Relay	Initiate the next component	Its role is similar to the detonating component
Booster	Initiate main explosive	Used to initiate blasting agents or cast TNT
Base charge	Detonate main composition	Usually a secondary explosive

The Priming Assembly would be a part of the "Primer" component listed above, which is responsible for initiating the device. It is also important to note that is does so nonelectrically. The difference between the two, though slight, makes a difference in how the initiation of an explosion takes place. A non-electric detonator is initiated by a signal conductor (a signal conductor that is coated with reactive material on the inside, or a detonating cord of low energy type. It can be developed with or without a delay or without one. In some detonators the primary charge has been replaced by another composition to get a detonator less sensitive to

[14] Akhavan, Jacqueline. *The Chemistry of Explosives*. Royal Society of Chemistry. http://books.google.com/books?id=9tIQDn2uZz4C&pg=PA70&lpg=PA70&dq=explosive+train&source=bl&ots=xiF00E9tdp&sig=IffWGZJvTt-_TnTezlO_neqrvF4&hl=en&ei=nLMWTL3tDcL68Abvl62RCQ&sa=X&oi=book_result&ct=result&resnum=12&ved=0CEMQ6AEwCw#v=onepage&q=explosive%20train&f=false

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mechanical impact.[15] Another main difference between electric and nonelectric initiation is safety. Electric initiation is more susceptible to accidental detonation due to radio, static electricity, and other interferences, however, the starter can be reusable[16]. All of that considered, nonelectric and electric initiators are comparable in cost[17]. As previously mentioned, the detonating device can either be electric or non-electric.

For safety reasons, the detonator is kept separate from the charge until it is time to set it off. In choosing the materials for detonation it is essential to pick items that will minimize the risk of accidental detonation.

While the triggering sequence of creating an explosion has been described, there are preparatory steps that must take place before that. These steps include: surveying the scene, deciding where to place charges and in what amounts, placing the charge, connecting the transfer lines and finally connecting the detonator. When multiple lengths of nonelectric explosive initiation materials are introduced to the situation, this set up can take even longer[18].

However, the use of the Priming Assembly can help reduce the set up time required in such situations for two primary reasons. One is that the need to cut precision lengths of the materials is eliminated due to the spool-like packaging of the system. Secondly, the tangling of the cords is less likely to occur as they are inserted into the Priming Assembly[19]. These technical aspects are revisited when prospective advantages are examined.

The components of the Priming Assembly, as detailed in Navy case 100,080 are outlined below followed by prospective advantages and development and safety considerations.

2.4 Components

The Priming Assembly is, "a plastic body with a series of features designed to accept the input of up to two (2) explosive detonators, a cavity of explosive booster material, and output channels for multiple nonelectric initiation materials." Sufficient booster material can be placed in the booster cavities to ensure the reliable initiation of multiple lengths of nonelectric materials. Further, the assembly, in the form of a spool, serves as packaging for accommodating lengths of nonelectric priming leads, which eliminates the need for the precision cutting of the lengths in the field[20].

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[15] *Detonator Systems.* SP Technical Research Institute of Sweden. <http://www.sp.se/en/index/services/detonators/detonators/Sidor/default.aspx>

[16] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.

[17] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.

[18] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.

[19] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.

[20] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.

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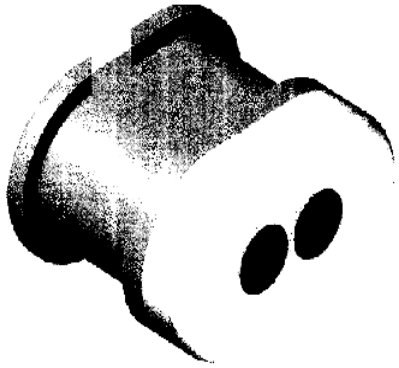

Figure 1: Simultaneous Dual Nonelectric Priming Assembly Concept (Front)

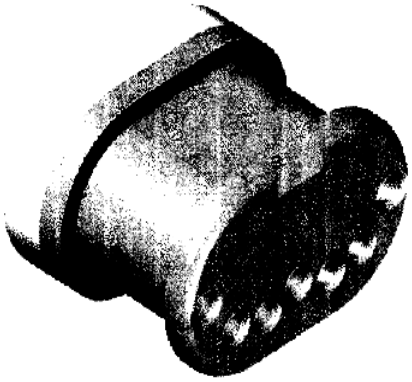

Figure 2: Simultaneous Dual Nonelectric Priming Assembly Concept (Rear)

The figures to the left illustrate these components of the Priming Assembly. Figure 1 shows the front of the assembly. The user may insert one or two detonators into the holes shown. The internal diameter of these detonator wells is surrounded by booster material. Figure 2 illustrates the rear of the assembly. This specific example shows the assembly able to take seven (7) leads of light load detcord. It is also important to note the overall design, specifically the slot and recessed feature surrounding the assembly, that is the spool for the leads.

2.5 Prospective Advantages

There are several prospective advantages associated with the Priming Assembly, which stem from its functionality, components, and design.

Prospective Advantage	Description
Decreased Set Up Time	The system eliminates the need for precision cutting of multiple lengths of materials (due to spool design) and avoids tangling the cords, both which can add time on target. Further, all leads come from one system. The inventor approximated the time savings at 2-3 minutes[21].
More Reliable	The system is more reliable than ad hoc methods due to the consistent, factory assembly[22].
Near Simultaneous Detonation	The system creates near simultaneous

[21] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.
[22] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.

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	detonation, with only a 10 microsecond spread[23].
Reduced and more efficient use of explosive material	Due to the increased reliability of the system, less excess material is needed to ensure complete detonation than in other method[24]s.
Increased safety	Since the system is prepackaged as a complete simultaneous nonelectric priming assembly, there is less risk of error than in other methods during set up, which is often the cause of accidental detonation[25].

In addition to these prospective advantages, it is important to note some of the new features that this system would bring to the marketplace:

1. The ability to initiate more than four (4) nonelectric initiation leads
2. The ability to accept more than one (1) detonators (dual priming)

The invention disclosure sums up these prospective advantages and new features when it states, "The net effect of these advantages is increased user effectiveness in reduced time, reduced effort and increased safety."

These potential improvements could be beneficial in a variety of demolition applications. However, this analysis explores the potential markets of:

- Military
- General Demolition
- Civilian First Responder

2.6 Additional Considerations

This *Technical Synopsis* has identified the prospective advantages of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly). While these prospective advantages may provide an outlet for product differentiation for the Priming Assembly, there are additional considerations that must be noted. The further development of the technology and safety issues associated with the invention could be challenges in bringing the technology to market. These factors are taken into consideration below in regard to the Priming Assembly. Through that analysis, there appears to be little development left to occur and the nature of the field of the invention is inherently dangerous, so neither of these should be large hurdles.

2.6.1 Development

The Priming Assembly is estimated to be at a Technology Readiness Level (TRL) of seven[26]. In other words, a system prototype has been tested in an operational environment[27]. With that said,

[23] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.
[24] Scheid, Eric. Navy Case 100,080. 8 Sept. 2009.
[25] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.
[26] Telephone correspondence with inventor, Eric Scheid. 3 June 2010.

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the assembly has not been deployed by the Navy or other forces as of the time this assessment was written.

Based upon the TRL definitions, this means that the actual system must still be completed and qualified through test and demonstration and then proven through successful mission operations. Discussions with the inventor indicated that prototype testing was positive and that these go-to-market needs should not present significant hurdles[28]. Without them though, the potential of the prospective advantages of the technology realizing their return on investment in the marketplace may be moot.

2.6.2 Safety

Any explosive device or blasting accessory must be used with constant safety precautions. As a blasting accessory, the Priming Assembly falls under this umbrella. Among the highest risks associated with the use of explosives is the possibility of accidental detonation. While the Priming Assembly provides a more reliable system that may in turn decrease the risk of accidental detonation, the safety concerns regarding blast injury should still be taken into consideration. It is important to note that the field of the invention is inherently risky, and therefore safety concerns should not limit market potential. The Priming Assembly's ability to potentially mitigate some of these concerns may actually enhance market potential. The following chart details some potential injuries that are risked when using explosives: [29]

Mechanisms of Blast Injury			
Category	Characteristics	Body Part Affected	Types of Injuries
Primary	Unique to high explosives, results from the impact of the over-pressurization wave with body surfaces.	Gas filled structures are most susceptible – lungs, GI tract, and middle ear.	• Blast lung (pulmonary barotraumas) • Tympanic membrane (TM) rupture and middle ear damage • Abdominal hemorrhage and perforation – Globe (eye) rupture – Concussion (Traumatic brain injury without physical signs of head injury)
Secondary	Results from flying debris and bomb fragments.	Any body part may be affected.	• Penetrating ballistic (fragmentation) or blunt injuries • Eye penetration (can be occult)

[27] http://esto.nasa.gov/files/TRL_definitions.pdf
[28] http://esto.nasa.gov/files/TRL_definitions.pdf
[29] "Explosives and Terrorists." 2005. The First Responder, Web. June 2010. <http://www.aristatek.com/Newsletter/05%2007%20July/The%20First%20Responder%20Explosives%20and%20Terrorists.htm>

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Tertiary	Results from individuals being thrown by the blast wind.	Any body part may be affected.	• Fracture and traumatic amputation • Closed and open brain injury
Quaternary	All explosion-related injuries, illnesses, or diseases not due to primary, secondary, or tertiary mechanisms. Includes exacerbation or complications of existing conditions.	Any body part may be affected.	• Burns (flash, partial, and full thickness) • Crush injuries • Closed and open brain injury • Asthma, Chronic obstructive pulmonary disease, or other breathing problems from dust, smoke, or toxic fumes • Angina • Hyperglycemia, hypertension

With proper training, arrangement, and utilization of the Priming Assembly, these risks can potentially be reduced. End-users of the Priming Assembly should be trained extensively and thoroughly on how to use the charge and how it can harm them.

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3 Applications

This assessment has examined the functional components and prospective advantages of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly). With those in mind, the core application of the Priming Assembly can be defined as the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials reliably, quickly, and safely. This broad application may be relevant to the following, more specific applications, with their corresponding markets (explored in section *4 Markets*) in parentheses

- Special Operations in Military (Military)
- Demolition, including in mining (General Demolition)
- Disaster Clean-Up (Civilian First Responder)
- Special Operations in Law Enforcement, including door breaching (Civilian First Responder)

3.1 Special Operations in Military

The Priming Assembly was invented at the Naval Surface Warfare Center (NSWC) Crane Division in response to problems in the field. Invented due to a lack of a system with such functionality, the system provides simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials reliably, quickly, and safely via a *pre-packaged* system. While the specific missions for which this technology was invented could not be released, it is known that the military uses explosives in special operations.

For example, the Army's Special Operations Forces' use of demolition dates back to pre-World War II, in which they used bulk explosives and non-standard, improvised methods.[30] Other branches of the military may use explosives in similar fashion. Of most relevance to the military may be decreased time on target. Extra time on target can lead to mission failure and/or increased exposure to hostile conditions. It is for these reasons that the Priming Assembly's prospective advantages may have increased relevance in such applications.

3.2 Demolition

Demolition, or to demolish, is defined as to tear down[31]. There are a variety of ways in which something can be torn down, one of which is performed by blasting. This is where the Priming Assembly may find application.

Demolition by blasting is used when alternative, usually safer and simpler, demolition methods cannot perform. These activities could include blasting buildings (intact or destroyed by some kind of disaster), bridges, other structures, or the rock and coal in mining[32].

[30] http://www.globalsecurity.org/military/systems/munitions/m303.htm
31 http://www.merriam-webster.com/dictionary/demolish
[32] http://www.globalsecurity.org/military/systems/munitions/explosives-mining1.htm

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The Priming Assembly may be especially relevant in mining applications where near simultaneous detonation is extremely important. For example, when fracturing rock, simultaneous shock waves are typically used. In addition, normally blasts within mines are sequenced to create a continuous low rumble. Precision and reliability are important in these sensitive situations and environments.

3.3 Disaster Clean-Up

As will be seen in section *4 Markets* of this analysis, disaster clean-up by first responders may actually not prove viable as an application. However, it is identified here as a potential application. Sources have demonstrated that disaster clean-up activities are usually performed by demolition contractors[33], and therefore this application is encompassed in the *Demolition* application.

3.4 Special Operations in Law Enforcement

Law enforcement personnel may use explosives in special operations, specifically in breaching doors. While there are several methods that can be used to breach doors[34], explosions are considered the fastest if set up time is not considered. With set up time considered, explosive entry may be one of the slowest methods of breaching. The Priming Assembly's simultaneous detonation functionality may make it particularly applicable in such situations, where this type of precision may be necessary. Its prospective advantages of ease of use and decreased set up time may help make explosive entry faster. The system may also be used in removing other structural barriers.

These applications, their purposes, and the advantages and disadvantages associated with each are summarized in the table on the following page.

[33] http://www.etrucker.com/apps/news/article.asp?id=54199
[34] http://www.cqb-team.com/Breaching.html

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Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly): Potential Advantages			
Application	Purpose	Advantages	Disadvantages
Military	• Special Operations in Military	• Decreased time on target • Increased safety • Reliability	• Not reusable
General demolition	• Building and other structure demolition • Loosening rock and coal for mining	• Decreased set up time • Increased safety • Reliable and complete detonation • Ability to simultaneously detonate charges	• Not reusable • Alternative demolition methods are safer and more simple
Disaster Clean-Up	• Building demolition • Removal of other barriers	• Decreased set up time • Increased safety • Reliable and complete detonation • Minimized haz-mat clean-up • Ability to simultaneously detonate charges	• Not reusable • Alternative demolition methods are safer and more simple
Special Operations in Law Enforcement	• Explosive entry—breaching a door • Entering buildings • Removal of barriers	• Decreased time on target • Increased safety • Reliable and complete detonation • Minimized haz-mat clean-up • Ability to simultaneously detonate charges	• Not reusable • Alternative demolition methods may be safer and more simple

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4 Markets

The uses examined above are used to identify prospective markets for the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) by recognizing the potential market relevance and end-user value that the technology may have in such situations. This assessment understands the core application of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) to be the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials reliably, quickly, and safely. Based upon this functionality and the applications previously explored, three corresponding market classifications have been identified within which market relevance may be found:

- Military Market
- Civilian First Responder Market
- General Demolition Market

Each market is defined and quantified and market drivers and influences are briefly explored.

4.1 Military Market

The Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) may find relevance and opportunity within the military market, specifically for special operations involving explosives. The decreased risk of accidental detonation, reliability, and decreased time on target due to ease of use may be the most relevant prospective advantages to this market.

4.1.1 Definition and Quantification

The Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) was invented at the Naval Surface Warfare Center (NSWC)—Crane Division, based upon a recognized need in the field. While it has not yet been fielded, there is a verified Navy need for such technology. Therefore, similar needs may exist among the other military forces. Its use by other military forces for special operations may extend the potential market for such a device.

The military market is first defined to include the five branches of the United States military: Air Force, Army, Coast Guard, Marine Corps and Navy. The tables below relay the United States Bureau of Labor Statistics 2009 estimates of current enlistment.[35] It is these enlisted and officer personnel who constitute the military market and may serve as potential end-users of the Priming Assembly.

[35] United States Bureau of Labor Statistics. "Occupational Outlook Handbook, 2010-11 Edition ." *Job Opportunities in the Armed Forces*. 17 Dec 2009. United States Department of Labor, Web. Mar 2010. <http://www.bls.gov/oco/ocos249.htm>.

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Military Enlisted Personnel by Broad Occupational Category & Branch of Military Service, January 2009						
Occupational Group - Enlisted	Army	Air Force	Coast Guard	Marine Corps	Navy	Total, all services
Administrative occupations	6,727	17,537	1,621	9,219	22,147	57,251
Combat specialty occupations	132,079	480	904	52,445	7,595	193,503
Construction occupations	20,872	4,689	—	6,759	5,521	37,841
Electronic and electrical repair occupations	37,466	34,751	4,663	16,199	47,985	141,064
Engineering, science, and technical occupations	42,770	41,328	1,212	26,940	38,778	151,028
Healthcare occupations	30,945	16,420	772	—	23,960	72,097
Human resource development occupations	20,251	11,321	1	7,134	5,300	44,007
Machine operator and precision work occupations	6,372	6,181	1,816	2,575	8,596	25,540
Media and public affairs occupations	8,233	6,910	152	2,518	3,659	21,472
Protective service occupations	29,076	34,099	2,816	7,156	12,555	85,702
Support services occupations	13,554	6,071	1,263	2,765	9,188	32,841
Transportation and material handling occupations	69,454	31,396	11,748	25,909	45,176	183,683
Vehicle machinery mechanic occupations	54,771	43,409	6,119	22,068	45,209	171,576
Non-occupation coded personnel	1,081	6,681	326	12	755	8,855
Total, by service	473,651	261,273	33,413	181,699	276,424	1,226,460

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Military Officer Personnel by Broad Occupational Category & Branch of Military Service, January 2009						
Occupational Group - Officer	Army	Air Force	Coast Guard	Marine Corps	Navy	Total, all services
Combat specialty occupations	20,201	2,611	77	5,315	1,125	29,329
Engineering, science, and technical occupations	21,676	17,800	210	4,006	7,616	51,308
Executive, administrative, and managerial occupations	13,104	7,327	197	2,725	5,442	28,795
Healthcare occupations	10,626	8,661	1	—	7,468	26,756
Human resource development occupations	2,676	2,293	151	279	520	5,919
Media and public affairs occupations	310	305	15	175	290	1,095
Protective service occupations	2,867	1,131	60	353	284	4,695
Support services occupations	1,741	758	3	38	857	3,397
Transportation occupations	12,519	22,828	580	7,345	27,340	70,612
Non-occupation coded personnel	2,597	866	6,769	88	386	10,706
Total, by service	88,317	64,580	8,063	20,324	51,328	232,612

Within the above tabulations, the total military market (as defined via BLS estimates of officer and enlisted personnel) consists of 1,459,072 members. Of course, some of these occupations are more likely to employ the Priming Assembly than others. For example, the "combat specialty operations" occupation is probably where most potential end-users of the Priming Assembly are classified. There are a total of 222,832 (or approximately 15%) members across the five branches employed in such positions. Further, the Navy only makes up 8,720 (almost 4%) of those members; meaning that while the Priming Assembly may have been developed to meet a Navy need, this may only be a small part of the potential military market. It is important to note that these quantification numbers cannot be equated to number of systems to be sold, but they do provide an estimate of the number of potential end-users that exist within the military.

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Moving forward, one method of further quantifying the potential military market may be via an examination of military deployment. Explosives and blasting accessories may be used by the military more frequently in combat zones as opposed to domestically. Military deployment may therefore serve as an indirect market indicator.

There are approximately 132,000 troops currently deployed within the Afghanistan and Iraq conflict zones. Beyond these combat initiatives, there are an estimated 194,895 troops deployed in foreign countries. Missions range from peacekeeping, to security, to military training—all of which may carry the possibility for use of explosives and blasting accessories. The map below provides a breakdown of some of the major deployments of U.S. military personnel totaling 326,895 in 2007.[36]

[36] CNN. "CNN.com." *Major U.S. Troop Deployments*. 09 Jan 2007. CNN, Web. Mar 2010. <http://www.cnn.com/interactive/maps/world/fullpage.troop.deployments/world.index.html>.

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Deployment Location	Estimated Number of U.S. Troops Deployed
Afghanistan	22,000
Bosnia & Herzegovina	200
Djibouti	3,000
Egypt	800
Europe	100,000
Iraq	132,000
Japan	35,300
Kosovo	1,500
Philippines	95
South Korea	32,000
Total	326,895

Based upon the assumption that explosives may be more frequently used in combat zones, the deployment statistics given here may further quantify the potential military end-users, The 326,895 designated to be within the military context of deployed locales would not all fall under the "combat specialty operations" occupation as previously examined, so this number is certainly an overestimate, yet it provides additional data to use going forward.

In addition to general enlistment figures and deployment statistics, federal budgets may also serve as a market indicator for the military market. While budgetary quantification of the market is not ideal, increasing relevant budgets may indicate a viable market need, as well as potential increases in purchasing power for the military end-user (*i.e*. military procurement). That said, as the Priming Assembly is examined as a new entrant to the military market, budgetary analysis will prove to be general in nature—neither historical nor predicted expenditures can be explicitly related to the Priming Assembly. This is in opposition, for example, to an examination of historical purchase patterns and prediction of future expenditures. A budgetary quantification of market opportunity will then examine those budget segments which have the potential to include Priming Assembly expenditure, and which may offer general insight into prospective military purchasing power.

The Department of Defense (DoD) requested $708 billion for fiscal year (FY) 2011. The budget includes $549 billion in discretionary budget authority to fund base defense programs and $159 billion to support overseas contingency operations (OCO), primarily in Afghanistan and Iraq.[37] The FY2011 base budget represents an increase of $18 billion over the $531 billion enacted for FY2010. This is an increase of 3.4 percent, or 1.8 percent real growth after adjusting for inflation.

In addition, procurement allocations within the DoD budget may also shed light on potential military purchasing power. If Priming Assembly licensees or manufacturers are able to penetrate the military market, procurement allocations may be the funds with which military end-users may purchase the Priming Assembly. Procurement appropriation is listed at $104.8 billion in

[37] U.S. Department of Defense, Office of the Assistant Secretary of Defense (Public Affairs). "DOD Releases Defense Reviews, 2011 Budget Proposal, and 2010 War Funding Supplemental Request - Update." Defense.gov News Release. U.S. Department of Defense, February 01, 2010. Web. May 2010. <http://www.defense.gov/Releases/Release.aspx?ReleaseID=13281>.

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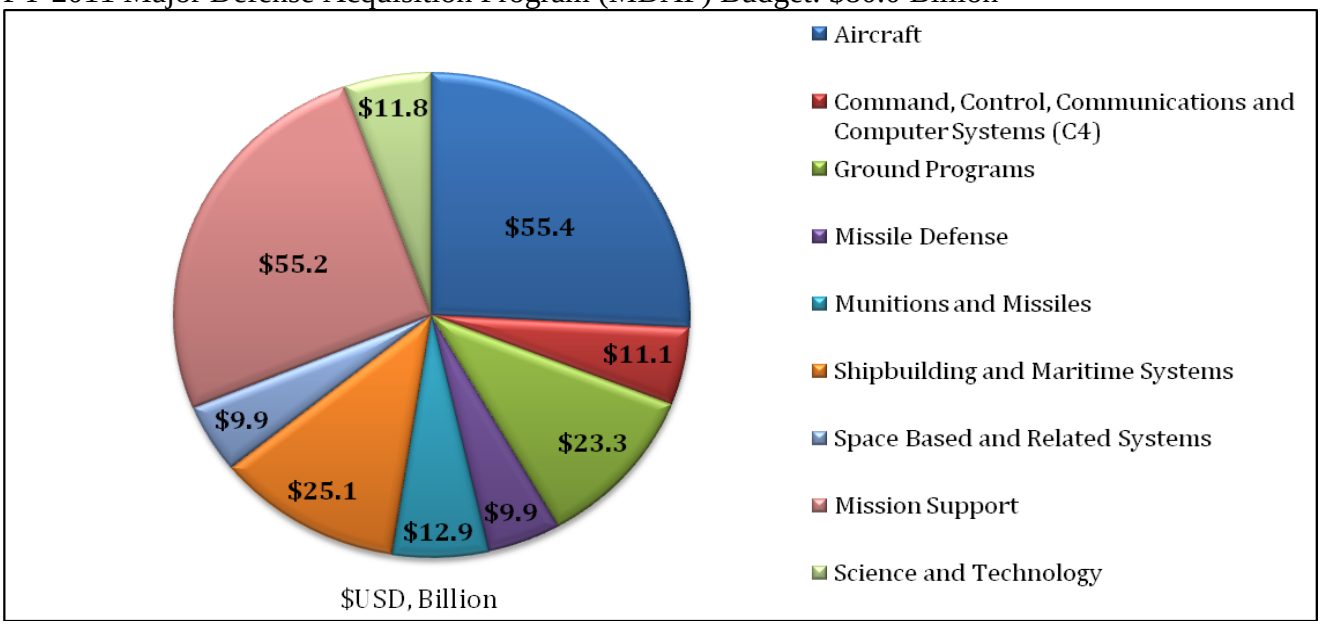
FY2010, projected to increase by 7.7% to $112.9 billion in FY2011. Again accepting budgetary quantification as representative of market priorities and here, procurement to be indicative of prospective purchasing power, opportunity within the military market appears to be increasing. Of course, an increasing procurement budget does not guarantee that budget comptrollers will allocate funds to purchase the Priming Assembly and the traditional value stream will need to be examined.

The FY 2011 procurement budget ($112.9 billion) can be further specified into programs designated as Major Defense Acquisition Programs (MDAP). $80.0 billion has been allocated for MDAP in FY2011. Funding categories are broken down by mission area to include:

FY 2011 Major Defense Acquisition Program (MDAP) Budget: $80.0 Billion[38]



Major Defense Acquisition Program	FY2011 Budget Allocation (billion $USD)
Aircraft	55.4
Command, Control, Communications and Computer (C4) Systems	11.1
Ground Programs	23.3
Missile Defense	9.9
Munitions and Missiles	12.9
Shipbuilding and Maritime Systems	25.1
Space Based and Related Systems	9.9
Mission Support	55.2
Science and Technology	11.8

[38] Ibid.

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Of the nine categories, *Ground Programs* may prove to be the most relevant to the Priming Assembly—acknowledging the potential for a change to the current technology of the satchel-like charge. The Ground Program (GP) allocation of $23.3 billion focuses primarily on modernizing ground force capabilities. While this once again does not serve as direct market quantification, it is noted here as potentially valuable information moving forward.

4.1.2 Market Drivers and Influence

In recognizing the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly)'s potential relevance within the military market, drivers and influences have been identified to include rates of deployment.

If the assumption is maintained that deployment may carry increased use of explosives and blast accessories, then rates of deployment may influence the potential military market for the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly). Although this assessment will not fully delve into the drivers behind force deployment, the previously quantified 326,895 troops may represent a large pool of existing potential end-users. As the United States administration recently approved the deployment of an additional 30,000 troops, the market driver of combat activity may remain relevant for the military market. Likewise, the United States Bureau of Labor Statistics (BLS) predicts that the number of active-duty military personnel is expected to remain relatively constant through 2019. The BLS goes on to state that recent conflicts and the resulting strain on military may lead to an increase in the number of active-duty personnel—a prospective increase in market size for the Priming Assembly.[39] Considerations should, however, be made for the volatile nature of markets reliant on wartime initiatives and/or the greater political climate.

4.2 General Demolition Market

This assessment understands the core application of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) (Priming Assembly) to be the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials reliably, quickly, and safely. The Priming Assembly may find market relevance in the general demolition market, specifically blasting. Based upon its prospective advantages this market relevance may stem from making the use of explosives in demolition quicker, safer, more reliable and less complex.

4.2.1 Definition and Quantification

Demolition, or to demolish, is defined as to tear down[40]. There are a variety of ways in which something can be torn down. However, some of these methods are considered to be safer than others, and usually the safest and simplest method that can perform the job is the one chosen[41].

[39] Bureau of Labor Statistics, United States Department of Labor. "Occupational Outlook Handbook, 2010-11 Edition." Job Opportunities in the Armed Forces. U.S. Bureau of Labor Statistics, 17 Dec 2009. Web. May 2010. <http://www.bls.gov/oco/ocos249.htm#outlook>.

40 http://www.merriam-webster.com/dictionary/demolish

41 http://ezinearticles.com/?Demolition---There-Are-Many-Different-Variations&id=1072853

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Alternative demolition techniques are further examined in the *Competition* section of this assessment. It is simply important to be aware that the overall demolition market is made of up several different activities outside of just blasting.

Just as military enlistment was used to quantify the military market, the number of establishments and total number of employees in the blasting industry can be used as initial quantification data for the general demolition market. This assessment will begin broadly and drill down to more specific employment statistics.

Those employed in general demolition would broadly fall within the "Specialty Trade Contractors" (NAICS 238). The Bureau of Labor Statistics estimates that approximately 3,535,700 people are employed under this category[42]. However, this broad characterization includes "Foundation, Structure, and Building Exterior Contractors," and "Building Equipment Contractors," among other occupations that would not necessarily include blasting. From here, we can drill down to NAICS 2389, "Other Specialty Trade Contractors," upon which the next section is based.

Under "Other Specialty Trade Contractors," the North American Industry Classification System (NAICS) code 238910 or "Site Preparation Contractors[43]" includes activities that are more specific to the Priming Assembly system. Every five years the U.S. Department of Commerce, in conjunction with the Economic and Statistics Administration and the U.S. Census Bureau, publishes the Economic Census. These reports provide information regarding the structure and functioning of the different industry sectors that make up the United States economy. Information in the NAICS 238910 report from 2002 is listed below[44]. This chart is incomplete, but the full chart and other relevant charts from the same report can be found in Appendix A.

[42] http://www.bls.gov/iag/tgs/iag238.htm
[43] http://www.naics.com/censusfiles/ND238910.HTM
[44] http://www.census.gov/prod/ec02/ec0223i238910.pdf

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Industry or bridge	Number of establishments	Total number of employees	Total payroll	Capital Expenditures, other than land
Site preparation contractors	30, 496	285,430	9,702,430	2,325,052
Support activities for oil and gas operations (pt)	176	3,673	129,301	31,968
Support activities for coal mining (pt)	83	848	28,416	D*
Support activities for metal mining (pt)	10	156	7,086	D*
Support activities for nonmetallic mining, except fuels (pt)	20	626	21,532	D*
Water, sewer, and pipeline construction (pt)	1,327	5,600	154,487	22,387
All other heavy construction (pt)	6,781	75,428	2,603,047	569,103
Excavation contractors 19 666	19,666	166,969	5,671,320	1,531,195
Wrecking and demolition contractors	2,097	28,540	944,597	137,193
All other special trade contractors (pt)	338	3,589	142,655	17,598

**D indicates data withheld to avoid disclosing data of individual companies; data are included in higher level totals*

Of the total 30,496 establishments, 2,097 (a little under 7%) are classified as "Wrecking and demolition contractors," and of the total 285,430 employees, 28,540 (almost 10%) fall within that same classification. Support activities for coal mining, metal mining, and nonmetallic mining, may also include a portion of the employees performing blasting, another 1,630 employees. While these employment statistics do not equate to the number of Priming Assembly systems to be purchased, they do provide an initial understanding of potential market size.

This assessment tried to obtain blasting rates and explosives usage rates without success. While these statistics would provide more direct quantification data and market indication, they appear to not be published publically.

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4.2.2 Market Drivers and Influences

While demolition may exist as a niche market, classified as "Other Specialty Trade Contractors," it is still impacted by external drivers and influences, just like any other market. Outside the prospective advantages of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) systems sales and market viability are likely dependent on the following major factors:

- Up-stream effects from end-user industries (particularly coal)
- Demolition rates

According to *The Institute of Makers of Explosives* (IME) the coal industry consumes 67 percent of explosives manufactured in the United States and is the largest application for explosives use in the United States.[45] The chart below breaks down consumption of explosives by industry:

Industry	% of Total Explosives Consumption
Coal	67
Quarrying and Nonmetal mining	14
Metal mining	9
Construction	7
Miscellaneous	3

Coal, Quarrying and Nonmetal mining, and Metal mining, are all somewhat related industries, and make up approximately 90 percent of the total explosives consumption in the United States. This chart is assumed to not account for military consumption. It is assumed that this total consumption corresponds with demolition activity taking place. Therefore, the general demolition market may be subject to up-stream effects stemming from the success or decline in the coal and related industries. However, the military market for explosives may serve as a buffer to these effects.

Interrelated are the demolition rates, which could not be quantified by this assessment. However, the one factor that may impact demolition rates is reviewed herein. Demolition rates may be impacted by the overall age or condition of buildings. Buildings in the United States are aging to points where they may be unusable and relocating may not be an option in highly urbanized areas[46]. Thus, the demolition of older buildings may be necessary to make room for new construction in these areas. As buildings continue to age, a need for demolition should continue to be present and may increase. The Priming Assembly could be employed in these demolitions, and therefore a need for it may continue to exist as well. However, the demolition rate for aging buildings is bound to be relatively small since construction accounts for only 7% of explosives consumption, compared to 67% for coal. While this market may grow, it will remain small compared to the existing coal mining market.

[45] http://business.highbeam.com/industry-reports/chemicals/explosives
[46] http://content.asce.org/conferences/aei/aging_buildings/index.html

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4.3 Civilian First Responder Market

The Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) may find relevance and opportunity within the civilian first responder market, specifically for law enforcement special operations and disaster clean-up. The decreased time on target, increased reliability and ability to detonate charges simultaneously may be the most relevant prospective advantages to this market.

4.3.1 Definition and Quantification

The civilian first responder market denotes civilian end-users within a non-military context. Unique to the civilian first responder market, however, is the characterization of civilian personnel *who hold first responder employment*. First responders may then include those grouped within the United States Bureau of Labor Statistics' occupation classifications of "protective services" and "healthcare practitioners and technical occupations." These two categories encompass the traditionally connoted civilian first responders of fire fighters, police officers, and emergency medical technicians (EMTs) and paramedics. The Bureau of Labor Statistics articulates the following employment figures for 2008 and the projected change from 2009 through 2018.[47]

First Responder Category	SOC Code	Employment 2008	Projected Employment 2018	Change, 2008-2018	
				Number	Percent
Fire Fighters	33-2011	310,400	367,900	57,500	16%
Police Officers	33-3050	665,700	723,300	57,600	8%
EMTS & Paramedics	29-2041	210,700	229,700	19,000	8%
Average		1,186,800	1,320,900	134,100	10%

When employment statistics are accepted as a market indicator for the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly), the civilian first responder market reveals positive indications of growth. Employment projections for each component of the civilian first responder market are positive. It is these first responders who may serve as end-users of the Priming Assembly when posed with threats requiring disaster clean-up or special operations using explosives.

[47] Bureau of Labor Statistics, United States Department of Labor. " **Occupational Employment Statistics**." Protective Service Occupations. U.S. Bureau of Labor Statistics, 14 May 2010. Web. May 2010. < http://www.bls.gov/oes/current/oes330000.htm>.

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The United States Fire Administration (USFA) reports the existence of 30,170 fire departments in 2009 with an estimated 52,400 fire stations in the United States.[48] The most recent data provided by the Bureau of Justice Statistics cites 17,876 state and local law enforcement agencies with the equivalent of at least one full-time officer operating in the United States in 2004.[49] The largest fifty law enforcement agencies are outlined below in accordance with the number of full-time sworn personnel. [50]

Agency	Full-time sworn personnel
New York (NY) Police	36,118
Chicago (IL) Police	13,129
Los Angeles (CA) Police	9,099
Los Angeles County (CA) Sheriff	8,239
California Highway Patrol	7,085
Philadelphia (PA) Police	6,832
Cook Co. (IL) Sheriff	5,555
Houston (TX) Police	5,092
New York State Police	4,667
Pennsylvania State Police	4,200
Washington (DC) Metropolitan Police	3,800
Detroit (MI) Police	3,512
Texas Department of Public Safety	3,437
Broward County (FL) Sheriff	3,190
Baltimore (MD) Police	3,160
Miami-Dade County (FL) Police	3,094
Dallas (TX) Police	2,935
Phoenix (AZ) Police	2,858
New Jersey State Police	2,768
Suffolk County (NY) Police	2,692
Las Vegas (NV) Metropolitan Police	2,674
Nassau County (NY) Police	2,574
Harris County (TX) Sheriff	2,545
Massachusetts State Police	2,200
San Francisco (CA) Police	2,167
Orange County (CA) Sheriff	2,119
San Diego (CA) Police	2,103
San Antonio (TX) Police	2,054

[48] United States Fire Administration, U.S. Federal Emergency Management Agency. "Fire Departments." USFA Fire Departments. FEMA, 12 Nov 2009. Web. May 2010. <http://www.usfa.dhs.gov/statistics/departments/index.shtm>.

[49] Bureau of Justice Statistics, Office of Justice Programs. "Census Of State And Local Law Enforcement Agencies, 2004." Bureau of Justice Statistics (BJS) - Publication and Product Details. Bureau of Justice Statistics, 23 Apr 2010. Web. May 2010. <http://bjs.ojp.usdoj.gov/index.cfm?ty=pbdetail&iid=539>.

[50] Ibid.

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Memphis (TN) Police	2,017
Illinois State Police	2,008
Boston (MA) Police	1,961
Milwaukee (WI) Police	1,946
Virginia State Police	1,869
Michigan State Police	1,862
Baltimore County (MD) Police	1,798
Honolulu (HI) Police	1,795
Columbus (OH) Police	1,777
Florida Highway Patrol	1,654
New Orleans (LA) Police	1,646
Atlanta (GA) Police	1,643
Jacksonville (FL) Sheriff	1,617
Port Authority of New York-New Jersey Police	1,607
Maryland State Police	1,596
Sacramento County (CA) Sheriff	1,565
Cleveland (OH) Police	1,560
San Bernardino County (CA) Sheriff	1,542
North Carolina State Highway Patrol	1,517
Ohio State HIghway Patrol	1,502
Riverside County (CA) Sheriff	1,490
Charlotte-Mecklenberg (NC) Police	1,483

These larger departments may be more likely to respond to events requiring the use of explosives, and therefore may represent the greatest first responder market opportunity.

However, as explored in the *General Demolition* section, first responder usage of such a device may be extremely limited, with only 3% of explosives consumption accounted for by miscellaneous use[51]. The first responder portion of this 3% (assuming it includes first responder purchases, which it may not) may be negligible as a market opportunity. Once again, this report is not intended to recommend one market over another, but the potential for obtaining a return on investment by only entering the first responder market alone appears like it would be a challenge.

On the same note, sources have indicated that many first responders do not have the skill sets necessary to create said explosions. First, the rule of thumb when performing demolition is to employ the safest and simplest method by which the job can be done[52]. With demolition by blasting or implosion being the riskiest and most complex method, this is usually not the first method used for most applications.

[51] http://business.highbeam.com/industry-reports/chemicals/explosives
[52] http://ezinearticles.com/?Demolition---There-Are-Many-Different-Variations&id=1072853

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Further, when situations require the use of explosives, particularly in disaster clean-up, first responder groups call in demolition contractors with the proper expertise[53]. Since the use of explosives is inherently risky, it makes sense to call the specialists. For example, demolition contractors were integral to clean up efforts following 9/11, U.S. Senate anthrax contamination, the demolition of the federal building in Oklahoma City, and Hurricane Katrina[54].

Demolition contractors were explored in the *General Demolition* market section. However, the National Demolition Association has asserted that demolition contractors should be considered part of first response teams[55]. While this idea is important to be aware of, demolition contractors do not fit the traditional definition of first responders and for the purposes of this assessment have not been considered part of the civilian first responder market.

4.3.2 Market Drivers and Influences

Thus far, this assessment has examined prospective Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) market relevance via end-user use of explosives. While analyzing the civilian first responder's use of explosives, the market appeared to be limited in both potential application and overall use.

The potential civilian first responder applications identified by this assessment include disaster clean-up and special operations by law enforcement. Looking further into the actual execution of such activities, demolition by blasting is usually not the technique of choice, unless it is necessary. In addition, if blasting is required, first responders are typically not using the explosives; demolition contractors specializing in blasting perform the activity.

As identified, based upon these observations, the first responder market may be limited or nonexistent. Absent a real market opportunity, market drivers and influences are also not present.

Potential Market	Method of Quantification	Drivers and Influences
Military	• Enlisted personnel • Deployment rate • Budget allocation	• Deployment rate
Civilian First Responder	• Employment statistics • Employment allocation	• Absence of a market opportunity→absence of drivers and influences
General Demolition	• Broad employment statistics • Specific employment statistics	• Up-stream effects from end-user industries • Demolition rates

[53] http://www.etrucker.com/apps/news/article.asp?id=54199
[54] http://www.etrucker.com/apps/news/article.asp?id=54199
[55] http://www.demolitionassociation.com/Portals/0/pdfs/DC_Strengthen_First_Response.pdf

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5 Competitive Landscape

This assessment has worked to establish the prospective advantages, core application, and potential markets of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly). Based upon those observations, competition for the Priming Assembly system may include currently fielded priming assemblies and the ad hoc method that utilizes tape. Further, the Priming Assembly may face competition from alternative demolition techniques in some applications, specifically those outside the military. Competition is examined based upon the identified prospective advantages of the Priming Assembly, namely decreased time on target, increased reliability, and the ability to detonate charges simultaneously. These prospective advantages may serve as points of product differentiation and competitive advantage. General industry notes are made, and examples of competing technologies and the firms offering them when applicable are explored.

5.1 Industry Composition and Trend

The Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly)'s core application has been defined as the simultaneous, dual priming of multiple lengths of nonelectric explosive initiation materials reliably, quickly, and safely. As previously stated, there are several components to the explosive train, which are necessary to creating an explosion. The manufacture of all of these components falls under the North American Industry Classification System (NAICS) code 325920, otherwise known as "Explosives Manufacturing." NAICS states that, "This industry comprises establishments primarily engaged in manufacturing explosives." It is important to note that the manufacture of ammunition, ammunition detonators, and percussion caps are classified under code 332992 "Small Arms Ammunition Manufacturing," and manufacturing pyrotechnics are classified under 325998 "All Other Miscellaneous Chemical Product and Preparation Manufacturing[56]."

In order to understand the types of activities included under 325920, the listing of said activities obtained from NAICS is reproduced below[57].

[56] http://www.naics.com/censusfiles/ND325920.HTM
[57] http://www.naics.com/censusfiles/ND325920.HTM

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Amatols manufacturing
Azides explosive materials manufacturing
Blasting accessories (e.g., caps, fuses, ignitors, squibbs) manufacturing
Blasting powders manufacturing
Caps, blasting and detonating, manufacturing
Cordite explosive materials manufacturing
Detonating caps, cord, fuses, and primers manufacturing
Detonators (except ammunition) manufacturing
Dynamite manufacturing
Explosives manufacturing
Gunpowder manufacturing
Mannitol hexanitrate explosive materials manufacturing
Mercury fulminate explosive materials manufacturing
Nitrocellulose explosive materials manufacturing
Nitroglycerin explosive materials manufacturing
Nitrostarch explosive materials manufacturing
Pentolite explosive materials manufacturing
Picric acid explosive materials manufacturing
Safety fuses, blasting, manufacturing
Styphnic acid explosive materials manufacturing
Tetryl explosive materials manufacturing
TNT (trinitrotoluene) manufacturing
Trinitrotoluene (TNT) manufacturing

Not surprisingly, NAICS 325920 "Explosives Manufacturing," includes the manufacture of the actual explosive materials and chemicals, such as TNT. The root of the NAICS code, 32, indicates "Manufacturing," while the 325 at the beginning of the code indicates, "Chemical Manufacturing.[58]" However, as can be seen in the list above, NAICS 325920 also includes the manufacture of blasting accessories such as caps, fuses, ignitors, and squibbs. Detonators, detonating caps, cord, fuses and primers can also be considered blasting accessories. Based upon these observations, the Priming Assembly would be considered a blasting accessory as well since it does not include the explosives themselves.

Now that the Priming Assembly has been identified as part of NAICS 325920 "Explosives Manufacturing" industry, information about this industry can provide an understanding of industry composition. Every five years the U.S. Department of Commerce, in conjunction with the Economic and Statistics Administration and the U.S. Census Bureau, publishes the Economic Census. These reports provide information regarding the structure and functioning of the different industry sectors that make up the United States economy. Information in the NAICS 325920 report from 2002 and the available 2007 data set that has not been published in report form yet have been used as a starting point for industry analysis. These statistics are summarized in the chart below[59],[60]. This chart does not include all information from the source, but a full chart and other relevant charts can be found in Appendix B.

[58] http://www.bls.gov/iag/tgs/iag325.htm
[59] http://www.census.gov/prod/ec02/ec0231i325920.pdf

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Industry and year	Companies *	All establish-ments	# of employees	Payroll ($1,000)	Total value of shipments ($1,000)	Total capital expenditures ($1,000)
2007**	56	83	6,532	311,010	1,736,670	38,974
2002	56	88	5,633	227,701	1,026,888	24,887
2001	N	N	6,473	252,708	1,085.924	24,109
2000	N	N	7,957	301,832	1,134,959	24,176
1999	N	N	8,680	301,334	1,011,811	40,320
1998	N	N	8,410	296,903	1,247,881	59,903
1997	66	103	8,972	312,301	1,447,274	44,209

**For the census, a company is defined as a business organization consisting of one establishment or more under common ownership or control.*
***Please note that 2003-2006 data sets are not available as the 2007 Economic Census has not been published in report format yet. According to the 2007 Economic Census Data Release Schedule, manufacturing sector reports are scheduled for release through the third quarter of 2011. A more specific breakdown of industry segment releases is not given*[61].

The value of shipments for the Explosives Manufacturing market in 2007 exceeded $1.7 billion. Explosive materials are likely to account for a large fraction of that value (the NAICS statistics do not break down total revenue by component). A short-run prototype of the Priming Assembly cost $24/piece. However, the Priming Assembly is estimated to cost $5 at higher quantities after purchasing a mold. The assembly is used with charges that are estimated to cost approximately $250. The Priming Assembly market could potentially amount to some tens of millions per year.

As can be seen in the above chart regarding the Explosives Manufacturing industry, there appeared to be a downward trend from 1997-2002. However, the 2007 data set shows an increase in number of employees, payroll, total value of shipments, and total capital expenditures. With missing 2003-2006 data, it is hard to get a comprehensive view of what has happened in this industry.

Regardless, some trends are identified; the number of firms decreased from 1997-2002, yet stayed stagnant in the period from 2002-2007, and the number of establishments has decreased. Based upon this information and other sources, merger and acquisition (M&A) activity in the scientific and technical equipment (STE) instrumentation market, which is assumed to include explosives manufacturing, has been high in recent years,[62] although the recent economic downturn has negatively impacted M&A activity[63].

Before further exploring M&A activity in the Explosives Manufacturing market, data regarding the size of firms, based upon number of employees, is presented below[64].

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[60]http://factfinder.census.gov/servlet/IBQTable?_bm=y&-ds_name=EC0731I1&-NAICS2007=325920&-_lang=en
[61] http://www.census.gov/econ/census07/www/data_release_schedule/index.html
[62]http://www.merger.com/admin/research/uploads/Mergers,%20Acquisitions%20and%20Consolidation%20in%20the%20Instrumentation%20Market.pdf
[63] http://www.reuters.com/article/idUSTRE54P5NW20090526
[64] http://www.census.gov/prod/ec02/ec0231i325920.pdf

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Employment Size Class	All Establishments	# of Employees	Payroll ($1,000)
1 to 4 employees	23	60	2,974
5 to 9 employees	9	58	2,612
10 to 19 employees	10	129	5,927
20 to 49 employees	21	676	27,189
50 to 99 employees	10	737	24,579
100 to 249 employees	10	1,810	78, 621
250 to 499 employees	4	G	D
500 to 999 employees	-	-	-
1,000 to 2,499 employees	1	G	D
2,500 employees or more	-	-	-

- Represents zero
g Indicates 1,000 to 2,499 employees
D Indicates data withheld to avoid disclosing data of individual companies; data are included in higher level totals

According to the Economic Census, only one firm in this industry had greater than 1,000 employees. The United States Small Business Administration (SBA) defines small business in the NAICS code 325920 to be those having less than 750 employees[65]. All but one firm in the industry are classified as small businesses, representing a fragmented industry. A list of all companies in this industry is presented in Appendix C.

However, through independent research, two leaders in the industry were found, Dyno Nobel and Orica. Both of these companies' product lines include blasting accessories, and more specifically they include primers. According to Hoover's, Orica has 700 employees[66] and Dyno Nobel has 2,701 employees[67], which are clearly not represented on the above chart. With that said, the Economic Census data is from 2002 and may be out dated in this specific aspect, but overall it may still remain relevant to the broad characterization of fragmentation in the industry. It is important to note that Orica's 700 employees still classify it as a small business in accordance with the U.S. SBA's definition for NAICS code 325920.

Getting back to M&A activity, 10 firms out of 66 total firms were bought or went out of business during the period from 1997-2002. There was no data to confirm the mechanism by which these firms disappeared. However, in 2005, Orica purchased the European, Middle Eastern, African, Asian and Latin American businesses of Dyno Nobel[68]. Although this assessment is focusing on domestic industry, the second largest firm's acquisition of a significant portion of the largest firm's international business is important to note, since (along with the disappearance of firms) it suggests a trend to consolidation in the Explosives Manufacturing industry.

[65] http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf
[66] http://www.hoovers.com/company/Orica_USA_Inc/rryxjji-1.html
[67] http://www.hoovers.com/company/Dyno_Nobel_Inc/rrrjchi-1.html
[68] http://www.orica.com/BUSINESS/COR/orica/COR00254.NSF/Page/News_ffff

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With the trend of exiting firms, despite the still relatively fragmented market, this industry appears to be in the maturity phase of the industry life cycle[69]. In the maturity phase, new technology begins to drive the beginning of a new industry life cycle or introduction phase. In view of this characterization of the life cycle, the Priming Assembly could have greater viability in an industry that is looking for new technologies to spawn growth. The need for explosives is likely to remain stable, given the gradual nature of change in the energy industry and continued construction due to population growth. It is not to be expected that the explosives market will soon enter the decline phase; hence there will be time in the immediate further for product improvements, such as the Priming Assembly, to establish themselves.

5.2 Competition

As previously explored, limitations of the ad hoc method currently used in the field prompted the invention of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly). Being able to simultaneously, dual prime multiple lengths of nonelectric explosive initiation materials reliably, quickly, and safely, as claimed by the Priming Assembly, overcomes the identified limitations of historically deployed systems. However, this method is thought to have little to no cost associated with it, and therefore may serve as competition due to its cost effectiveness. Existing priming assemblies marketed by industry incumbents, including Dyno Nobel, Orica, and Ensign-Bickford, may serve as further competition. Alternative demolition methods are explored as imperfect substitutes.

5.2.1 Historically Deployed Systems

The limitations of the ad hoc method currently used in the field were mentioned earlier in this assessment and are reiterated with further analysis here. The ad hoc method refers to taping together the multiple lengths of explosive initiation material. One major disadvantage of this method is that the lengths must be cut very precisely in order to have a successful detonation. This task can be time consuming and complex for the user to perform.

Further, the following results can occur from using the ad hoc method; poor reliability, excessive explosive weight, excess time on target and poor results. Significant problems within the larger explosive blast system can result from any of these issues.

The functionality of the Priming Assembly is claimed to help reduce these risks, however, when comparing cost, the Priming Assembly has much greater cost associated with it than tape. Please find a chart of different types of tape below.

[69] http://www.referenceforbusiness.com/management/Or-Pr/Product-Life-Cycle-and-Industry-Life-Cycle.html

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Common Adhesive Tapes	
Types	**Description**
Duct tape	Duct tape is made of a cotton mesh web with a polyethylene coating. It was originally intended to be used as a water resistant seal for ammunition. Since then, it has been used in combat situations and as well as in emergency situations in NASA spaceflight.
Speed tape	Speed tape is an aluminum based tape created for temporary repairs to the body of planes, automobiles and other similar mobile technologies. Both NASA and the Air Force use speed tape for temporary fixes to damaged space shuttles and planes, respectively.
Electrical tape	Electrical tape is commonly made of vinyl, but can be consistent of many plastics. It was originally intended to conceal electrical wires and is not suggested for military use.
Gaffer tape	Gaffer tape is similar in content to duct tape, but has a less sticky, intense bound and does not leave behind residue when removed. It was originally intended for sealing ammunition boxes in combat situations.

Additionally, tape may be very economical for the end-user. Most explosive experts often carry a roll of adhesive tape with them at all times[70]. An ordinary, 50-yd roll of commercial duct tape can be purchased for $3-6 at any local hardware or home appliance store.[71] The multiple lengths of initiation material must be cut precisely in order to use tape which can be time consuming. However, two strips of tape would likely only be a few inches (3-6) long, the end-user could tape the materials together using only one foot of tape. Using only one foot of tape from a 50-yd roll for each explosive, the same end-user could theoretically successfully detonate 150 explosives with the same roll.

While the Priming Assembly may never be able to be priced comparatively to tape, competitive pricing, when the benefits of using the Priming Assembly outweigh the cost will be critical to its success in the marketplace. Further, the decreased time on target may warrant the premium charged for the Priming Assembly in some specific applications.

5.2.2 Existing Initiation Systems

This assessment has identified, and examined as potential competition, the product predecessor that provoked the invention of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) and its prospective advantages of decreased time on target, reliability and the ability to simultaneously detonate multiple charges. These predecessors may not be the only form of competition though. There are 56 companies operating in the Explosive Manufacturing industry, many of which produce blasting accessories that may serve as competition to the Priming Assembly.

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[70] E-mail correspondence with inventor Eric Scheid. 23 July 2010.

[71] Home Depot. *Tape.* (2010). Web. July 2010. <http://www.homedepot.com/webapp/wcs/stores/servlet/Navigation?storeId=10051&categoryID=502234&langId=-1&catalogId=10053&navFlow=3&searchRedirect=duct%20tape&cm_sp=searchredirect-_-bm_tape_flcat_duct_tape-_-x-_-x&locStoreNum=4136&marketID=106>

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Upon review of Dyno Nobel, Orica, and Ensign-Bickford's product offerings, it was found that these companies do produce blasting accessories[72],[73],[74]. However, none of these solutions allow for the simultaneous detonation of multiple charges. This may mean that while the decreased time on target, reliability and safety are all important advantages of the Priming Assembly, its competitive advantage may stem from its ability to simultaneously detonate multiple charges. This should be kept in mind as this new technology is marketed. Additionally, the market for the Priming Assembly may be limited to applications where simultaneous detonation of multiple charges is necessary.

5.2.3 Alternative Demolition Techniques

When an explosion must be used, the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) appears to offer significant advantages over other systems. However, in applications such as disaster clean-up or door breaching, where explosions may be used, there are alternative demolition techniques that may prove to be imperfect substitutes to the Priming Assembly. In other words, demolition by blasting is not always the preferable method. It is important to note that demolition by blasting, specifically employing the Priming Assembly, could prove complementary to alternative techniques though.

Demolition, or to demolish, is defined as to tear down[75]. There are a variety of ways in which something can be torn down. However, some of these methods are considered to be safer than others, and usually the safest and simplest method that can perform the job is the one chosen[76]. The alternative demolition techniques are examined by this assessment in relation to this general rule of thumb. The analysis progresses from those techniques considered most safe to those considered less safe.

The pulling down of a structure is referred to as manual demolition. While this method is the simplest and potentially the safest, it can only be used for small buildings, for example, single story homes[77].
The pulling and knocking down of a structure is known as mechanical demolition. The simplest type of mechanical method involves heavy machinery such as cranes, bulldozers, and excavators, and is considered to be one of the safest methods of demolition[78].

As structures get larger, mechanical demolition becomes more complex. This complexity requires the use of wrecking balls, which are more dangerous than the heavy machinery used in less complex situations, such as cranes[79].

72http://www.dynonobel.com/dynonobelcom/en/global/productsandservices/northamerica/Products+%28march2006%29/
73 http://www.eba-d.com/defense/shock_tube.php
74 http://www.oricaminingservices.com/us/en/page/products_and_services/initiating_systems/initiating_systems
75 http://www.merriam-webster.com/dictionary/demolish
76 http://ezinearticles.com/?Demolition---There-Are-Many-Different-Variations&id=1072853
77 http://ezinearticles.com/?Demolition---There-Are-Many-Different-Variations&id=1072853
78 http://www.fixr.com/blog/2010/03/15/5-types-of-demolition/
79 http://ezinearticles.com/?Demolition---There-Are-Many-Different-Variations&id=1072853

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If mechanical demolition is not able to produce the desired results, undermining will be used. Undermining refers to the removal of important supporting structures, causing the building to collapse. This is most frequently done through blasting or implosion, in which explosive charges are strategically placed to remove the desired supports. The Priming Assembly would be used in this type of demolition. However, several sources note that this method is only used as a last resort[80] and it is the most risky. This assessment was unable to quantify the number of demolitions per year or the rate at which demolition is performed by blasting.

Although the quantification is lacking, it is known that demolition by blasting, or implosion, is considered the most risky method of demolition and will not be employed unless the other methods cannot be performed. This assessment has also observed that when simultaneous detonation is the end goal, the Priming Assembly may provide the safest, most reliable and easy to use system, due to a lack of similar systems. If the prospective advantages of the system make implosion by simultaneous detonation less risky and complicated, it may be used more often in applications that typically defer to safer, simpler methods currently, such as disaster clean-up and building demolition. However, for this to occur, the risk and complexity levels would need to fall below those of the alternative demolition methods examined herein. While this is not impossible, it may be unlikely. Hence, the possibility of using the Priming Assembly to replace alternative demolition techniques is unlikely to augment its market viability.

5.3 Pricing Considerations

Pricing considerations for the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) are explored based upon its main prospective advantages of decreased time on target, increased reliability, and ability to simultaneously detonate multiple lengths of initiation material.

A short-run prototype of the Priming Assembly cost $24/piece. However, the Priming Assembly is estimated to cost $5 at higher quantities after purchasing a mold. The assembly is used with charges that are estimated to cost approximately $250.

In addition, the competition information examined in the previous sections reveals a lack of directly competing technologies in the marketplace. While the advantages and lack of competitors may be muted in the first responder market due to little to no use of such technology, these factors may foster pricing power in the military and general demolition markets.

80 http://www.fixr.com/blog/2010/03/15/5-types-of-demolition/

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6 Cautions and Considerations

This assessment has strived to examine the core application, prospective advantages, potential markets, and competitive landscape for the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly). Although these analyses have overall proven favorable, there are some observations that may warrant caution and/or additional consideration.

By the nature of the invention, the manufacture of the Priming Assembly may be subject to certain federal regulations set forth by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). According to a 2007 publication by ATF titled *Federal Explosives Law and Regulations*, it is required that anyone importing, manufacturing, or dealing in explosive materials have a permit to do so. The report defines explosive material as, "explosives, blasting agents, or detonators.[81]"

Moving forward, although this assessment is not written to suggest one market over another, it does work to provide substantial data for such a decision to be made. Based upon the markets examined—military, general demolition, and civilian first responder--, the civilian first responder market may prove less viable than the others. Despite favorable employment projects, the number of those employees designated as first responders using demolition by blasting appears limited to nonexistent.

Demolition by blasting is usually used as a last resort in these types of situations, with alternative demolition methodologies taking precedence. Additionally, when demolition by blasting is employed in disaster clean-up situations, demolition contractors specializing in this area are usually called in. First responders are simply not trained in such skills. However, there may be a very small niche present in law enforcement special operations, such as door breaching. Upon market entry, this potential market should not be overlooked, but it should be noted that return on investment in this market alone may be limited.

On that same note, when reviewing the historical purchasers of explosive materials and blasting accessories caution may also be warranted. With 67% of total explosive consumption accounted for by the coal industry, it appears that the explosives industry may be somewhat dependent upon a surviving coal industry. The following chart tabulates the overall explosives consumption by industry[82].

Industry	% of Total Explosives Consumption
Coal	67
Quarrying and Nonmetal mining	14
Metal mining	9
Construction	7
Miscellaneous	3

[81] http://www.atf.gov/publications/download/p/atf-p-5400-7.pdf
[82] http://business.highbeam.com/industry-reports/chemicals/explosives

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While the three largest consumers of explosives are related industries, this data is assumed to not reflect military consumption. The Explosives Manufacturing industry may be subject to up-stream effects stemming from the success or decline in the coal and related industries, however, the military market for explosives may serve as a buffer to these effects.

Additionally, users who are accustomed to the current way of achieving similar effects, through using tape, may be resistant to adopt such a new technology. While the Priming Assembly may decreased the time on target and complexity of simultaneous detonation, there is also likely some training involved. Some people in the field may feel that they are efficient in the use of tape and be resistant to change. The Priming Assembly also is something else to keep track of in the field. Since most folks already carry tape, it is likely easy to find.

As previously mentioned, tape is less costly than using a plastic device such as the Priming Assembly. In order to be viable in the marketplace, end-users will need to value the prospective advantages of decreased time on target, increased reliability, and the simultaneous detonation functionality of the Priming Assembly in specific applications.

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7 Conclusion

This analysis has worked to provide a general overview of the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) and prospective market opportunities. Four applications: *special operations in the military, general demolition, disaster clean-up and special operation in law enforcement*, and their three corresponding markets within which the Priming Assembly may find relevance were examined including, but not limited to the: *military market, civilian first responder market*, and the *general demolition market*. Each potential market was defined, quantified, and market drivers and influences were explored. Initial pricing analysis based upon the Priming Assembly systems prototype cost estimates, and competing technologies were examined.

The prospective advantages of the Priming Assembly system, including *decreased time on target, increased reliability, and the ability to simultaneously detonate multiple charges*, all proved relevant to such applications identified. Although the ad hoc method is currently used in many of the applications mentioned, these prospective advantages may foster the use of the Priming Assembly.

While this assessment has not be written to recommend one market over another, the *Markets* section of this report may provide substantial data for such a decision to be made. The "Combat Specialty Operations" employment statistics showed that the Navy only employs a small portion (4%)[83] of the potential end-users for the Priming Assembly. The system was invented to solve a Navy problem, but the other branches of the military may represent a large portion of potential end-users and untapped market opportunity.

Further, the general demolition market, specifically coal mining and related mining industries represented 90% of explosives consumption in the United States, which is assumed to not include military consumption. With that said, it will likely be important to establish value and branding in this market for successful return on investment. The value of shipments for the Explosives Manufacturing market in 2007 exceeded $1.7 billion[84]. Explosive materials are likely to account for a large fraction of that value (the NAICS statistics do not break down total revenue by component). A short-run prototype of the Priming Assembly cost $24/piece. However, the Priming Assembly is estimated to cost $5 at higher quantities after purchasing a mold. The assembly is used with charges that are estimated to cost approximately $250.

The third market examined, civilian first responder, was observed to be limited to nonexistent. While applications exist in disaster clean-up, first responders seldom are the one performing this activity with explosives. Instead, demolition contractors[85], which are accounted for in the general demolition market are usually called in to execute such activities.

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[83] United States Bureau of Labor Statistics. "Occupational Outlook Handbook, 2010-11 Edition ." *Job Opportunities in the Armed Forces*. 17 Dec 2009. United States Department of Labor, Web. Mar 2010. <http://www.bls.gov/oco/ocos249.htm>.

[84] http://factfinder.census.gov/servlet/IBQTable?_bm=y&-ds_name=EC0731I1&-NAICS2007=325920&-_lang=en

[85] http://www.etrucker.com/apps/news/article.asp?id=54199

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The Explosives Manufacturing industry, as classified by NAICS 325920, appears to be in the maturity phase, with industry consolidation occurring. This niche industry may not be large enough for a full consolidation to run its course, but it also is not so small that it is likely to completely die out. According to the 2002 Economic Census on this industry[86] and the United States Small Business Administration[87], there is only one firm that is not classified as a "small business," creating a relatively fragmented market.

Independent research revealed the large firm to be Dyno Nobel. Another industry leader is Orica. These companies produce blasting accessories, including primers, but there was no direct competitor to the Priming Assembly found. The ad hoc method and existing primers were examined as potential competitors, but they do not have the ability to simultaneously detonate multiple charges. With that said, when demolition by blasting involving multiple charges (needing near simultaneous detonation) is required, the system may be a preferable device.

However, in many applications demolition by blasting is only used if necessitated by the job at hand. Otherwise, a safer and simpler alternative demolition technique will be used. These were examined in the body of this assessment.

Overall, the Simultaneous (Dual) Nonelectric Priming Assembly (Priming Assembly) appears to have market relevance in the applications examined. With no direct competitors, it may also hold considerable pricing power. Market viability will be dependent upon a licensee's ability to navigate the distribution channels of the mining related and military markets and to create tailored value propositions for the device that solves a niche problem in niche industries.

[86] http://www.census.gov/prod/ec02/ec0231i325920.pdf
[87] http://www.sba.gov/idc/groups/public/documents/sba_homepage/serv_sstd_tablepdf.pdf

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Appendix A—NAICS 238910 Site Preparation Contractor Charts

Table 1. **Industry Statistics on 2002 NAICS Basis Distributed Among 1997 NAICS-Based Industries for the United States: 2002**

[Thousand dollars unless otherwise noted. Detail may not add to total because of rounding. Data based on the 2002 Economic Census. For information on confidentiality protection, sampling error, and nonsampling error, see note at end of table. For meaning of abbreviations and symbols, see introductory text. For explanation of terms, see Appendix A. For detailed title descriptions, see Appendix F]

2002 NAICS code	1997 bridge code	Industry or bridge	Number of establishments	Total number of employees	Total payroll	Value of construction work[1]	Net value of construction work	Value added	Cost of materials, components, supplies, and fuels	Capital expenditures, other than land
			A	B	C	D	E	F	G	H
238910		Site preparation contractors	30 496	285 430	9 702 430	37 442 354	32 286 385	23 114 914	9 706 114	2 325 052
	21311200	Support activities for oil and gas operations (pt)	176	3 673	129 301	400 116	358 857	305 832	71 556	31 968
	21311300	Support activities for coal mining (pt)	83	848	28 416	86 985	82 590	66 770	D	D
	21311400	Support activities for metal mining (pt)	10	156	7 086	27 988	24 562	20 727	D	D
	21311500	Support activities for nonmetallic mining, except fuels (pt)	20	626	21 532	67 046	56 341	52 113	D	D
	23491000	Water, sewer, and pipeline construction (pt)	1 327	5 600	154 487	607 294	576 266	371 685	215 139	22 387
	23499000	All other heavy construction (pt)	6 781	75 428	2 603 047	10 595 897	9 004 424	6 151 557	2 961 537	569 103
	23593000	Excavation contractors	19 666	166 969	5 671 320	22 106 373	19 000 097	13 523 157	5 805 023	1 531 195
	23594000	Wrecking and demolition contractors	2 097	28 540	944 587	3 143 854	2 795 180	2 314 188	530 401	137 193
	23599000	All other special trade contractors (pt)	338	3 589	142 655	406 801	388 067	308 887	81 784	17 598

[1]For the 2002 Economic Census, the definition of value of construction work has been modified from the 1997 Economic Census definition. See Appendix A for the modified definition.

Note: The data in this table are based on the 2002 Economic Census. To maintain confidentiality, the Census Bureau suppresses data to protect the identity of any business or individual. The census results in this table contain sampling errors and nonsampling errors. Data users who create their own estimates using data from American FactFinder tables should cite the Census Bureau as the source of the original data only. For explanation of terms, see Appendix A. For full technical documentation, see Appendix C.

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Table 2. **Employment Statistics for Establishments by State: 2002**

[Detail may not add to total because of rounding. Data based on the 2002 Economic Census. For information on confidentiality protection, sampling error, nonsampling error, and geographical definitions, see note at end of table. For information on geographic areas followed by *, see Appendix D. For meaning of abbreviations and symbols, see introductory text. For explanation of terms, see Appendix A]

Location of establishment	Number of establishments	Number of employees		Number of construction workers				Payroll (thousand dollars)		Relative standard error of estimate (percent) for column—
		Total	Construction workers	January to March	April to June	July to September	October to December	Total	Construction workers	
	A	B	C	D	E	F	G	H	I	B
238910, Site preparation contractors										
United States	30 496	285 430	223 045	S	226 487	239 723	227 124	9 702 430	7 111 989	1
Alabama	387	4 617	3 660	3 543	3 691	3 832	3 574	115 527	82 656	9
Alaska	222	1 371	D	691	1 377	1 490	D	52 049	43 022	11
Arizona	564	6 012	4 787	4 451	4 627	5 156	4 914	198 146	143 105	8
Arkansas	279	1 557	1 193	1 058	1 219	1 225	1 270	39 866	29 062	11
California	1 876	30 599	24 712	22 836	24 451	26 220	25 342	1 228 241	924 360	6
Colorado	962	8 617	6 817	6 282	7 046	7 348	6 592	293 957	218 900	8
Connecticut	557	4 342	3 371	2 949	3 430	3 550	3 556	191 010	133 042	8
Delaware	82	D	772	743	777	796	774	32 617	24 597	S
District of Columbia	3	D	D	D	D	D	D	D	D	S
Florida	1 359	14 044	10 967	10 658	10 973	11 130	11 106	402 842	291 161	7
Georgia	933	8 027	6 239	5 875	6 258	6 384	6 438	260 212	190 104	5
Hawaii	53	1 409	1 138	1 044	1 131	1 222	1 156	61 243	47 247	6
Idaho	331	1 868	1 407	1 109	1 360	1 635	1 524	47 122	34 165	12
Illinois	1 010	12 196	9 207	7 967	9 481	9 866	9 513	518 608	380 863	6
Indiana	859	7 020	5 515	4 858	5 608	6 066	5 529	227 994	168 846	7
Iowa	320	2 145	1 629	1 181	1 684	1 905	1 744	74 159	56 107	10
Kansas	227	2 911	2 410	2 386	2 454	2 448	2 350	98 698	74 857	13
Kentucky	426	3 291	2 535	2 427	2 708	2 626	2 379	98 296	78 067	10
Louisiana	168	4 213	3 395	3 250	3 441	3 407	3 482	124 957	93 437	10
Maine	405	3 796	2 647	2 201	2 639	2 896	2 852	110 092	70 365	7
Maryland	452	5 741	4 485	4 357	4 574	4 548	4 460	195 516	138 278	5
Massachusetts	915	8 522	6 708	5 941	6 864	7 224	6 802	339 879	247 015	6
Michigan	1 328	9 174	7 057	5 780	7 540	7 767	7 141	325 127	247 101	6
Minnesota	779	6 078	4 590	3 020	5 157	5 362	4 822	230 465	175 087	7
Mississippi	223	1 802	D	D	1 369	1 456	1 431	45 974	31 592	13
Missouri	681	4 806	3 728	3 405	3 871	3 899	3 739	150 924	114 088	9
Montana	280	1 472	1 152	861	1 148	1 386	1 211	34 667	25 032	17
Nebraska	158	1 899	1 546	1 286	1 501	1 813	1 586	63 915	45 651	4
Nevada	203	3 526	2 976	2 719	2 902	3 103	3 178	135 659	104 821	7
New Hampshire	359	2 549	D	D	2 035	2 126	1 909	86 335	D	10
New Jersey	816	9 025	6 844	6 086	6 764	7 336	7 191	355 012	248 279	8
New Mexico	89	1 083	863	886	829	880	857	33 472	24 014	8
New York	1 479	14 229	D	D	11 500	12 390	11 774	516 475	D	8
North Carolina	1 222	9 121	7 018	6 644	7 126	7 295	7 005	253 534	178 545	8
North Dakota	86	920	701	505	697	870	731	27 425	19 931	15
Ohio	1 432	10 643	8 328	7 050	8 544	9 300	8 419	340 790	253 146	7
Oklahoma	288	2 134	1 664	1 572	1 715	1 731	1 639	62 237	42 530	10
Oregon	598	4 366	3 509	2 908	3 378	3 983	3 766	123 592	91 661	18
Pennsylvania	1 586	13 123	10 163	8 928	10 225	10 997	10 502	444 246	D	5
Rhode Island	153	1 398	1 150	958	1 097	1 280	1 266	52 738	42 716	9
South Carolina	573	4 442	3 436	3 398	3 463	3 512	3 371	128 522	88 658	7
South Dakota	148	880	D	500	D	D	D	24 725	16 817	9
Tennessee	695	4 926	3 807	3 517	3 947	4 019	3 746	145 010	101 150	8
Texas	1 449	13 996	10 897	10 109	10 973	11 433	11 072	415 296	296 831	5
Utah	348	2 766	2 267	1 873	2 368	2 535	2 291	75 114	56 060	11
Vermont	295	1 678	1 262	959	1 331	1 460	1 298	50 653	37 108	10
Virginia	739	9 051	7 203	6 782	7 179	7 412	7 438	294 777	214 564	7
Washington	881	7 474	5 811	5 338	5 962	6 531	5 413	272 992	195 546	8
West Virginia	328	2 133	1 534	D	D	1 603	1 564	52 249	39 713	11
Wisconsin	766	6 495	5 117	3 987	5 270	5 865	5 345	227 531	175 136	8
Wyoming	124	939	605	523	649	697	550	D	D	8

Note: The data in this table are based on the 2002 Economic Census. To maintain confidentiality, the Census Bureau suppresses data to protect the identity of any business or individual. The census results in this table contain sampling errors and nonsampling errors. Data users who create their own estimates using data from American FactFinder tables should cite the Census Bureau as the source of the original data only. For explanation of terms, see Appendix A. For full technical documentation, see Appendix C. For geographical definitions, see Appendix D.

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Table 5. **Selected Statistics for Establishments by Employment Size Class: 2002**

[Detail may not add to total because of rounding. Data based on the 2002 Economic Census. For information on confidentiality protection, sampling error, and nonsampling error, see note at end of table. For meaning of abbreviations and symbols, see introductory text. For explanation of terms, see Appendix A]

Employment size class	E[1]	Number of establishments	Total number of employees	Total payroll	Value of business done[2]	Value of construction work[2]	Net value of construction work	Value added	Cost of materials, components, supplies, and fuels	Cost of construction work subcontracted out to others	Relative standard error of estimate (percent) for column—
	A	B	C	D	E	F	G	H	I	J	C
238910, Site preparation contractors											
All establishments	1	30 496	285 430	9 702 430	37 976 997	37 442 354	32 286 385	23 114 914	9 706 114	5 155 969	1
Establishments with—											
1 to 4 employees	–	17 700	37 060	814 834	4 144 260	4 086 783	3 716 149	2 550 463	1 223 164	370 634	3
5 to 9 employees	–	6 166	38 094	1 067 096	4 091 260	4 043 303	3 678 126	2 669 843	1 056 240	365 177	4
10 to 19 employees	–	3 519	46 310	1 501 273	5 384 831	5 285 202	4 710 332	3 494 081	1 315 880	574 869	4
20 to 49 employees	–	2 169	64 626	2 350 233	8 524 309	8 391 393	7 248 203	5 266 714	2 114 406	1 143 190	3
50 to 99 employees	–	657	44 367	1 771 825	6 914 627	6 814 085	5 711 878	4 079 572	1 732 848	1 102 207	3
100 to 249 employees	–	227	32 440	1 278 388	4 973 125	4 910 831	4 035 136	2 924 926	1 172 504	875 696	1
250 to 499 employees	–	47	15 685	627 260	2 497 436	2 466 653	2 079 016	1 448 626	661 173	387 637	6
500 to 999 employees	–	11	6 848	291 522	1 447 149	1 444 103	1 107 544	680 690	429 900	336 559	–
1,000 employees or more	–	–	–	–	–	–	–	–	–	–	–

[1]Construction receipts were obtained from census respondent forms. For establishments whose respondent forms were not received at the time data were tabulated, these data were calculated using industry averages and imputation for nonresponse. The following symbols are shown where estimated imputation-based data on construction receipts account for 10 percent or more of the figures shown: 1–10 to 19 percent; 2–20 to 29 percent; 3–30 to 39 percent; 4–40 to 49 percent; 5–50 to 59 percent; 6–60 to 69 percent; 7–70 to 79 percent; 8–80 to 89 percent; 9–90 percent or more.

[2]For the 2002 Economic Census, the definitions of value of business done and value of construction work has been modified from the 1997 Economic Census definition. See Appendix A for the modified definitions.

Note: The data in this table are based on the 2002 Economic Census. To maintain confidentiality, the Census Bureau suppresses data to protect the identity of any business or individual. The census results in this table contain sampling errors and nonsampling errors. Data users who create their own estimates using data from American FactFinder tables should cite the Census Bureau as the source of the original data only. For explanation of terms, see Appendix A. For full technical documentation, see Appendix C.

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Table 9. **Value of Business Done for Establishments by Kind-of-Business Activity: 2002**

[Thousand dollars unless otherwise noted. Detail may not add to total because of rounding. Based on their primary business activity or combination of activities, establishments were classified into this specific industry. These establishments, however, may also be engaged in other kinds of business activities. Data based on the 2002 Economic Census. For information on confidentiality protection, sampling error, and nonsampling error, see note at end of table. For meaning of abbreviations and symbols,see introductory text. For explanation of terms, see Appendix A]

Primary and other kind of business activities	Value of business done[1]	Relative standard error of estimate (percent)
238910, Site preparation contractors		
Total	37 976 997	1
Heavy construction and civil engineering construction, total	10 181 798	3
Excavation work, earthmoving or land clearing contractor, not connected with buildings	10 181 798	3
Special trade contractors, total	20 937 555	2
Excavation work: earthmoving or land clearing contractor, connected with buildings	15 162 580	2
Foundation digging, drilling, or pile driving contractor	2 943 345	3
Wrecking, demolition, or blasting contractor, connected with buildings	2 831 630	3
All other construction activities	6 326 725	2
Other business activities secondary to construction activities, total	530 919	4
All other business activities secondary to construction activities	530 919	4

[1]For the 2002 Economic Census, the definition of value of business done has been modified from the 1997 Economic Census definition. See Appendix A for the modified definition.

Note: The data in this table are based on the 2002 Economic Census. To maintain confidentiality, the Census Bureau suppresses data to protect the identity of any business or individual. The census results in this table contain sampling errors and nonsampling errors. Data users who create their own estimates using data from American FactFinder tables should cite the Census Bureau as the source of the original data only. For explanation of terms, see Appendix A. For full technical documentation, see Appendix C.

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Table 10. Selected Statistics for Establishments by Specialization in Kind-of-Business Activity: 2002

[Thousand dollars unless otherwise noted. Detail may not add to total because of rounding. This table presents selected statistics for establishments according to degree of specialization by major activity of construction work. If number of establishments or value of construction work for a given type of specialization are relatively insignificant, data may not be shown. In addition, data are not shown in this table where distribution of the value of business done by kind of business activity was not provided in Table 9. Data based on the 2002 Economic Census. For information on confidentiality protection, sampling error, and nonsampling error, see note at end of table. For meaning of abbreviations and symbols, see introductory text. For explanation of terms, see Appendix A]

Item	Number of establishments	Total number of employees	Total payroll	Value of construction work for specialized kind of business	Net value of construction work	Value added	Cost of construction work subcontracted out to others	Relative standard error of estimate (percent) for column—
	A	B	C	D	E	F	G	G
238910, Site preparation contractors								
Total	30 496	285 430	9 702 430	X	32 286 385	23 114 914	5 155 969	2
Establishments specializing 51 percent or more	26 136	248 856	8 522 107	26 908 758	28 443 279	20 388 478	4 494 298	2
Heavy construction and civil engineering construction, total								
Establishments specializing 51 percent or more	6 652	73 400	2 529 872	7 882 801	8 731 755	6 024 952	1 564 719	3
Specialization 100 percent	2 911	25 486	838 567	3 365 121	2 940 855	2 114 477	424 265	11
Specialization 90 to 99 percent	633	6 661	213 698	810 923	746 269	537 033	119 130	12
Specialization 80 to 89 percent	452	6 126	210 308	663 831	684 353	499 758	127 672	6
Specialization 70 to 79 percent	890	7 721	244 809	738 170	831 404	575 307	176 610	4
Specialization 60 to 69 percent	524	7 440	270 409	653 802	893 294	633 296	164 543	4
Specialization 51 to 59 percent	1 242	19 965	752 082	1 650 955	2 635 580	1 665 082	552 499	3
Excavation work, earthmoving or land clearing contractor, not connected with buildings								
Establishments specializing 51 percent or more	6 652	73 400	2 529 872	7 882 801	8 731 755	6 024 952	1 564 719	3
Specialization 100 percent	2 911	25 486	838 567	3 365 121	2 940 855	2 114 477	424 265	11
Specialization 90 to 99 percent	633	6 661	213 698	810 923	746 269	537 033	119 130	11
Specialization 80 to 89 percent	452	6 126	210 308	663 831	684 353	499 758	127 672	5
Specialization 70 to 79 percent	890	7 721	244 809	738 170	831 404	575 307	176 610	4
Specialization 60 to 69 percent	524	7 440	270 409	653 802	893 294	633 296	164 543	4
Specialization 51 to 59 percent	1 242	19 965	752 082	1 650 955	2 635 580	1 665 082	552 499	3
Special trade contractors, total								
Establishments specializing 51 percent or more	16 966	155 747	5 337 121	17 076 042	17 680 345	12 898 979	2 784 527	3
Specialization 100 percent	8 659	66 644	2 167 440	8 090 629	7 181 396	5 352 957	909 233	4
Specialization 90 to 99 percent	1 545	18 956	689 501	2 537 365	2 376 284	1 726 252	337 884	6
Specialization 80 to 89 percent	1 442	14 922	593 196	1 725 410	1 826 279	1 372 914	280 177	9
Specialization 70 to 79 percent	2 011	19 605	669 861	1 870 296	2 178 088	1 509 700	390 413	4
Specialization 60 to 69 percent	1 901	17 578	584 259	1 420 798	1 934 775	1 376 052	349 936	7
Specialization 51 to 59 percent	1 407	18 040	632 866	1 431 545	2 183 523	1 561 104	516 884	10
Excavation work: earthmoving or land clearing contractor, connected with buildings								
Establishments specializing 51 percent or more	13 658	115 517	3 889 528	12 566 267	13 164 128	9 439 968	2 234 529	3
Specialization 100 percent	6 880	43 775	1 362 555	5 282 496	4 649 556	3 457 242	632 940	5
Specialization 90 to 99 percent	1 330	15 183	556 415	2 076 495	1 952 601	1 394 240	273 382	7
Specialization 80 to 89 percent	1 033	10 774	429 578	1 292 439	1 353 872	985 565	231 148	11
Specialization 70 to 79 percent	1 792	16 016	512 100	1 452 656	1 688 457	1 124 458	304 728	5
Specialization 60 to 69 percent	1 471	13 772	457 464	1 155 604	1 548 659	1 089 605	304 397	8
Specialization 51 to 59 percent	1 152	15 996	571 416	1 306 578	1 970 983	1 388 859	487 934	10
Foundation digging, drilling, or pile driving contractor								
Establishments specializing 51 percent or more	1 587	15 995	648 645	2 094 677	2 117 901	1 467 746	232 920	3
Specialization 100 percent	762	9 675	406 201	1 424 296	1 303 292	894 897	121 004	5
Specialization 90 to 99 percent	90	967	28 600	106 125	107 961	75 014	5 845	20
Specialization 80 to 89 percent	167	1 130	37 518	129 012	142 460	97 977	12 416	18
Specialization 70 to 79 percent	62	1 998	103 302	274 836	310 662	223 962	70 321	2
Specialization 60 to 69 percent	314	1 412	52 629	116 917	176 564	123 426	16 590	25
Specialization 51 to 59 percent	193	814	20 395	43 492	76 962	52 471	6 744	25

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Appendix B—NAICS 325920 Explosives Manufacturing Charts

Table 1. Historical Statistics for the Industry: 2002 and Earlier Years

[Data based on the 2002 Economic Census and the 2002 Annual Survey of Manufactures (ASM). For information on confidentiality protection, sampling error, nonsampling error, and explanation of terms, see note at end of table. For meaning of abbreviations and symbols, see introductory text]

Industry and year[1]	Companies[2]	All establishments[3]	All employees		Production workers			Value added ($1,000)	Total cost of materials ($1,000)	Total value of shipments ($1,000)	Total capital expenditures ($1,000)
			Number[4]	Payroll ($1,000)	Number[4]	Hours (1,000)	Wages ($1,000)				
325920, Explosives manufacturing..... 2002..	56	88	5 633	227 701	4 124	7 652	137 724	596 813	416 733	1 026 888	'24 887
2001..	N	N	6 473	252 708	4 612	8 830	143 304	605 487	492 527	1 085 924	24 109
2000..	N	N	7 957	301 832	5 398	10 491	167 554	642 628	500 417	1 134 959	24 176
1999..	N	N	8 680	301 334	5 928	11 069	175 210	504 696	507 741	1 011 811	40 320
1998..	N	N	8 410	296 903	6 039	11 712	179 198	612 345	623 284	1 247 881	59 903
1997..	66	103	8 972	312 301	6 648	13 516	190 534	789 782	649 413	1 447 274	44 209

[1]Statistics presented for years ending in 2 and 7 are census data. Interim census years are derived in a representative sample of manufacturing establishments canvassed in the Annual Survey of Manufactures (ASM).

[2]For the census, a company is defined as a business organization consisting of one establishment or more under common ownership or control.

[3]Includes establishments with payroll at any time during the year.

[4]Number of employees figures represent average number of production workers for pay period that includes the 12th of March, May, August, and November plus other employees for payroll period that includes the 12th of March.

Note: The data in this table are based on the 2002 Economic Census and the 2002 Annual Survey of Manufactures (ASM). To maintain confidentiality, the Census Bureau suppresses data to protect the identity of any business or individual. The census results in this table contain sampling errors and nonsampling errors. Data users who create their own estimates using data from American FactFinder tables should cite the Census Bureau as the source of the original data only. For explanation of terms, see Appendix A. For full technical documentation, see Appendix C.

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Table 4. **Industry Statistics by Employment Size: 2002**

[Data based on the 2002 Economic Census. For information on confidentiality protection, nonsampling error, and explanation of terms, see note at end of table. For meaning of abbreviations and symbols, see introductory text]

Employment size class	E[1]	All establishments[2]	All employees		Production workers			Value added ($1,000)	Total cost of materials ($1,000)	Total value of shipments ($1,000)	Total capital expenditures ($1,000)
			Number[3]	Payroll ($1,000)	Number[3]	Hours (1,000)	Wages ($1,000)				
325920, Explosives manufacturing											
All establishments	–	88	5 633	227 701	4 124	7 652	137 724	596 813	416 733	1 026 888	r24 887
Establishments with—											
1 to 4 employees	2	23	60	2 374	39	73	1 159	8 823	6 161	15 076	r261
5 to 9 employees	2	9	58	2 612	46	87	1 714	21 840	23 482	45 235	r1 543
10 to 19 employees	2	10	129	5 927	81	157	2 420	13 349	16 984	30 780	r503
20 to 49 employees	2	21	676	27 189	439	812	14 015	81 679	100 091	182 796	r3 148
50 to 99 employees	–	10	737	24 579	634	1 190	17 123	70 881	44 849	116 726	r1 920
100 to 249 employees	–	10	1 810	78 621	1 185	2 386	44 409	213 664	170 827	393 134	10 127
250 to 499 employees	–	4	g	D	D	D	D	D	D	D	D
500 to 999 employees	–	–	–	–	–	–	–	–	–	–	–
1,000 to 2,499 employees	–	1	g	D	D	D	D	D	D	D	D
2,500 employees or more	–	–	–	–	–	–	–	–	–	–	–
Administrative records[4]	9	21	94	3 718	73	141	2 012	7 208	4 980	12 187	r240

[1]Some payroll and sales data for small single-establishment companies with up to 20 employees (cutoff varied by industry) were obtained from administrative records of other government agencies rather than from census report forms. These data were then used in conjunction with industry averages to estimate statistics for these small establishments. This technique was also used for a small number of other establishments whose reports were not received at the time data were tabulated. The following symbols are shown where estimated data account for 10 percent or more of the figures shown: 1–10 to 19 percent; 2–20 to 29 percent; 3–30 to 39 percent; 4–40 to 49 percent; 5–50 to 59 percent; 6–60 to 69 percent; 7–70 to 79 percent; 8–80 to 89 percent; 9–90 percent or more.

[2]Includes establishments with payroll at any time during the year.

[3]Number of employees figures represent average number of production workers for pay period that includes the 12th of March, May, August, and November plus other employees for payroll period that includes the 12th of March.

[4]Some payroll and sales data for small single-establishment companies with up to 20 employees (cutoff varied by industry) were obtained from administrative records of other government agencies rather than from census report forms. These data were then used in conjunction with industry averages to estimate statistics for these small establishments. Data are also included in respective size classes shown.

Note: The data in this table are based on the 2002 Economic Census. To maintain confidentiality, the Census Bureau suppresses data to protect the identity of any business or individual. The census results in this table contain nonsampling errors. Data users who create their own estimates using data from American FactFinder tables should cite the Census Bureau as the source of the original data only. For explanation of terms, see Appendix A. For full technical documentation, see Appendix C.

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Appendix C—Explosives Manufacturing Companies

Accurate Energetic Systems L.L.C.
AEL Zambia PLC
African Explosives Ltd.
African ExplosivesLtd. (Accra, Ghana)
African ExplosivesLtd. (Gaborone, Botswana)
African ExplosivesLtd. (Mwanza, Tanzania)
Al Fajar Al Alamia Company SAOG
American Pioneer Powder Inc.
Anhui Leimingkehua Company Ltd.
Asean Explotech Inc.
Austin Detonator S.R.O.
Austin Powder Argentina S.A.
Austin Powder Co.
Blastgard International Inc.
Britanite S/A Industrias Quimicas
Buckley Powder Co.
Bulk Mining Explosives Proprietary Ltd.
Cartridge Actuated Devices Inc.
Cascade Cartridge International S.A. de C.V.
Davey Bickford S.N.C.
DetNet Solutions Proprietary Ltd.
Dyno Nobel A.S.
Dyno Nobel Canada Inc.
Dyno Nobel Incorporated North America
Dyno Nobel Proprietary Ltd.
Elephant Industria Quimica Ltda.
Emirates Explosives L.L.C.
Enaex S.A.
Ensign-Bickford Industries Inc.
Eurenco Bofors AB
Explosivos Alaveses S.A.
Explosivos De Norteamerica S.A. de C.V.
Exsa S.A.
Famesa Explosivos S.A.C.
Forcit Ab
Four-D Enterprises Inc.
Golden West Products IInternational Inc.
Guizhou Jiulian Civil Explosion Equipment Development Company Ltd.
Gulf Oil Corporation Ltd.
Hanley Industries Inc.
Hanwha Corp.
Hitech Holding Inc.
HITECH Inc.
Hodgdon Powder Company Inc.

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Hokkaido NOF Corp.
Hunan Guosheng Fireworks Industrial Company Ltd.
Hunan Liuyang Fireworks Company Ltd.
Hunan Nanling Civil Blasting Material Company Ltd.
Inbrasfogos Com. E Industry Brasileira Fogos S.
Irish Industrial Explosives Ltd.
Japan Carlit Company Ltd.
Keltech Energies Ltd.
Ladshaw Explosives Inc.
Liaoning Qingyang Chemical Industrial Co.
Maxam Bulgaria AD
MaxamCorp Holding S.L.
Nippo Kogyo Company Ltd.
Nippon Koki Company Ltd.
Nitrochimie S.N.C.
Noble Explochem Ltd.
Orica Brasil Ltda.
Orica Colombia S.A.
Orica USA Inc.
Premier Explosives Ltd.
Saudi Chemical Co.
Shandong Biaozhi Garment Factory
Shanxi Guangling Jinghua Chemical Group Company Ltd.
Shanxi Jiangyang Chemical Company Ltd.
Showa Kinzoku Kogyo Company Ltd.
Slurry Explosive Corp.
SNPE Materiaux Energetiques S.A.
SNPE S.A.
Societe Anonyme d'Explosifs et de Produits Chimiques
Societe Tunisienne d'Explosifs et de Munitions S.A.
Tamil Nadu Industrial Explosives Ltd.
Tec Harseim Ltda.
Titan Completion Products Ltd.
Titanobel S.A.S.
UEE-Dantex Explosives Proprietary Ltd.
Viking Explosives and Supply Inc.
Walker's Holdings Inc.
Xi'an Beifang Qinghua Electric Appliance Company Ltd.

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